PATENT SPECIFICATION (11) 1278 168

1278 168

NO DRAWINGS

(21) Application No. 18605/70 (22) Filed 17 April 1970

(31) Convention Application No. 30456 (32) Filed 19 April 1969 in

(33) Japan (JA)

(45) Complete Specification published 14 June 1972

(51) International Classification B32B 7/06, 27/06 // B44D 1/00

(52) Index at acceptance

B5N 17X 17Y 220 22X 22Y 234 238 241 250 252X 252Y 254Y 255Y 266Y 270X 270Y 280Y 285Y 290Y 297Y 315 423 424 670 679 682 685 745 750 781

B2E 184 18Y 198 207 208 209 228 235 236 238 23Y 246 286 287 28Y 299 305 307 319 31Y 339 368 388 431 435 439 43X 43Y 447 44Y 473 485 486 487 493 498 49Y 507 508 50Y 533 53Y 545 546 547 557 55Y 567 568 56Y 578

(54) STRIPPABLE FILM

(71) We, SEKISUI KAGAKU KOGYO KABUSHIKI KAISHA, a Japanese Body Corporate of 1, Soze-cho, Kita-ku, Osaka, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a strippable film suitable for protecting the surface of an article.

Articles made of such materials as metals, synthetic resins, wood, or glass have been sold with their surfaces protected by paper or synthetic resin films in order to prevent damage during storage, transportation and processing. However, paper and synthetic resin films have the disadvantage that they tend to become detatched from an article during handling and fail to protect its surface. To overcome this a water-soluble paste or pressure-sensitive adhesive has been used to prevent the paper or synthetic resin film from separating from the surface of the article. This has the disadvantage, however, that when such a paper or synthetic resin film is removed from the surface of the article there is often left some of the paste or adhesive on the surface of the article. The removal of this remaining paste or adhesive is complicated and time consuming.

The present invention provides a strippable film which can be easily applied to the surface of an article, adheres well to the article, can be stripped off easily without leaving any trace on the surface of the article, is easy to handle, and is moreover low in cost. The strippable film of the invention comprises a flexible support and, on one surface of the support, a layer of a film-forming thermoplastic polymer containing carboxylic ester groups and having a critical surface tension of 34 to 40 dynes/cm., a softening point of at least 40°C. and a Shore D hardness of not more than 60.

The flexible support may be a cloth, paper, regenerated cellulose film, polyethylene film, polypropylene film, polyester film, polyamide film or polyvinyl chloride film, with a polyethylene film being particularly preferred. The critical surface tension of the thermoplastic polymer layer must be from 34 to 40 dynes/cm since a critical surface tension of below 33 dynes/cm does not provide good adhesion whereas a critical surface tension above 41 dynes/cm produces too strong an adhesive bond making the film difficult to remove from the surface of the article. The preferred values for the critical surface tension are from 35 to 37 dynes/cm.

Thermoplastic polymer layers having a softening point below 40°C. are tacky at room temperature, and are difficult to handle. Moreover, dust adheres to such thermoplastic polymer layers, resulting in a reduction in adhesive strength. The preferred softening points are from 40 to 70°C.

Thermoplastic polymer layers having a Shore D hardness of above 60 become hard and lose adhesive strength. The preferred range of values for the Shore D hardness is from 10 to 40.

(The critical surface tensions quoted in this specification have been measured in accordance with the method of W. A. Zisman described at pages 183—185 of "Adhesion and Cohesion", edited by Phillip Weiss and published by Elsevier Publishing Co., 1962, in the United States of America. The softening point is measured by the Vicat method. The hardness is measured by means of a Shore hardness tester, and indicates D hardness).

Examples of thermoplastic polymers which may be used in forming the layer on the flexible support are polyvinylacetate, a co-

polymer of vinyl acetate with a copolymerisable monomer, a polyacrylate or a copolymer of an acrylic acid ester with a copolymerisable monomer. Of these, an ethylene/vinyl acetate copolymer and an ethylene/acrylic acid ester copolymer are particularly preferred. These polymers may be used in mixtures with synthetic rubbers, paraffinic waxes, terpene resins and petroleum resins.

The layer of the thermoplastic polymer may be provided on a surface of the flexible support by any suitable method, for example by melt-extrusion coating, solution coating or hot melt coating. If the flexible support is itself formed from a thermoplastic polymer, a two-layer extrusion method can be employed by which the support and the surface layer of the thermoplastic polymer are simultaneously extruded. Alternatively the support can be hot pressed to a pre-formed film of the thermoplastic polymer.

Any of these methods ensures a sufficient adhesive bond between the support and the thermoplastic polymer layer. It is possible, however, to enhance the affinity between the support and the thermoplastic polymer layer by subjecting the support to a surface treatment before applying the layer of the thermoplastic polymer. Suitable such treatments include, corona-discharge treatment, flame treatment, oxidation treatment or primer treatment. The corona-discharge treatment is most preferred because the operation is easy to effect and good adhesion can be obtained.

The strippable film of the invention may be used to protect the surface of an article by pressing against the surface the layer of thermoplastic polymer of the strippable film. The article preferably is heated to 30—120°C. When the article, such as a board or sheet, is heated during the course of production, it is convenient to superpose the strippable film on said article while it is still hot. This obviates an extra heating step. The strippable film and the article may be pressed together by a press roll.

The surface of the article need not be smooth, and the strippable film of the invention can be applied to articles having embossed surfaces. The strippable film of the invention as described hereinabove does not adhere to other materials during handling and is easy to handle. Light pressing of the film ensures an adequate adhesive bond and a strippable film adhered to an article does not spontaneously part from the surface, with the result that the surface of the article is well protected. The adhesive strength of the strippable film of the invention is almost constant over a long period of time, and the film can be removed from an article merely by pulling without leaving any trace on the surface of the article.

The nature of the support may be varied according to the end use of the strippable film. For instance, if a transparent film is used as the support, an article can be examined while the strippable film of the invention is in place on its surface. This is particularly useful when the surface of the article is printed with a trade-name or size.

When a polyethylene film is used as the support, a sheet such as a synthetic resin or metal sheet can be subjected to a deforming processing whilst the strippable film is adhered to the surface of such sheet, and therefore, the surface of the sheet is not injured during processing. This is due to a good elongation of the polyethylene film.

The invention will now be described by reference to the following Examples.

EXAMPLE 1

A 50-micron thick film obtained by extrusion of low density polyethylene was used as a support. A copolymer of vinyle acetate and ethylene was used as a thermoplastic polymer and was coated on one surface of the support to a thickness of 20 microns by melt-extrusion, to form a strippable film having a thickness of 70 microns. The vinyl acetate/ethylene copolymer had a vinyl acetate content of 18% by weight, a melt index of 20, a softening point of 60°C., a Shore D hardness of 30, and a critical surface tension of 35 dynes/cm.

The strippable film so obtained was lightly pressed onto an acrylic resin bake coated steel sheet heated to 40°C. and a 18—8 stainless steel sheet, using a rubber roll. For comparison, a film of low density polyethylene, which had been subjected to a corona-discharge treatment and which had a critical surface tension of 43 dynes/cm, and a Shore D hardness of 60, and a film of low density polyethylene which had a critical surface tension of 31 dynes/cm and a Shore D hardness of 60 were adhered to the above-mentioned articles in the same way.

A peel-off test was conducted on these articles whose surfaces had been protected. The results are shown in Table 1.

TABLE 1

	Acrylic resin bake coated steel sheet				18—8 stainless steel			
	Immediately after adhesion at room temperature	Stored for 20 days at room temperature	Stored for 60 days at room temperature	Stored for 10 days at 40°C.	Immediately after adhesion at room temperature	Stored for 20 days at room temperature	Stored for 60 days at room temperature	Stored for 10 days at 40°C.
Peel-off strength of the film of the invention	50	50	50	50	70	70	70	80
Peel-off strength of the low density polyethylene	0	/	/	/	0	/	/	/
Peel-off strength of the low density polyethylene film corona-treated	100	not stripped; film broken	not stripped; film broken	not stripped; film broken	350	not stripped; film broken	not stripped; film broken	not stripped; film broken

The peel-off strength was expressed in g/30 mm, and measured by folding back an end portion of the strippable film to the opposite side at an angle of 180° at a pulling rate of 300 mm/min. in an atmosphere at 20°C. using a Schopper-type tensile tester.

EXAMPLE 2

A 50-micron thick film obtained by extrusion of low density polyethylene was used as a support. A copolymer of ethyl acrylate and ethylene was used as thermoplastic polymer and was coated on one surface of the support to a thickness of 20 microns by melt-extrusion, to form a strippable film having a thickness of 70 microns. The ethyl acrylate ethylene copolymer had an ethyl acrylate content of 20% by weight, a melt index of 12, a softening point of 50°., a Shore D hardness of 30, and a critical surface tension of 37 dynes per centimeter.

The strippable film so obtained was adhered by light pressing to an acrylic resin sheet heated to 30°C. and a 18—8 stainless steel plate heated to 60°C., using a rubber roll. The articles whose surfaces had been protected by the strippable film were subjected to the peel-off strength test in the same way as in Example 1. The results are shown in Table 2.

TABLE 2

	Acrylic resin sheet				18—8 stainless steel			
	Immediately after adhesion at room temperature	Stored for 20 days at room temperature	Stored for 20 days at room temperature	Stored for 10 days at 40 °C.	Immediately after adhesion at room temperature	Stored for 20 days at room temperature	Stored for 60 days at room temperature	Stored for 10 days at 40 °C.
Peel-off strength of the film of the invention	30	30	30	30	100	100	100	100

It can be seen from the Examples that the peel-off strength of strippable films of the invention hardly changed even after prolonged storage, and the films could be easily stripped off from the articles without leaving any trace, but that a low density polyethylene film having a critical surface tension of 43 dynes/cm, which had been subjected to a corona-discharge treatment, was difficult to strip off when stored for a long time, and could not be stripped at all but broke after storage for 20 days at room temperature.

WHAT WE CLAIM IS:—

1. A strippable film suitable for protecting the surface of an article, the film comprising a flexible support and, on one surface of the support, a layer of a film-forming thermoplastic polymer containing carboxylic ester groups and having a critical surface tension of 34 to 40 dynes/cm., a softening point of at least 40°C. and a Shore D hardness of not more than 60.

2. A strippable film according to claim 1 wherein the thermoplastic polymer has a softening point of 40 to 70°C.

3. A strippable film according to claim 1 or 2 wherein the thermoplastic polymer has a Shore D hardness of 10 to 40.

4. A strippable film according to any one of the preceding claims wherein the thermoplastic polymer is a copolymer of ethylene and vinyl acetate, or is a copolymer of ethylene and an acrylic acid ester.

5. A strippable film according to any one of the preceding claims wherein the support is a polyethylene film.

6. A strippable film according to any one of the preceding claims wherein one surface of the support is treated by corona discharge.

7. A strippable film according to any one of the preceding claims substantially as described herein.

8. A method for protecting the surface of an article, the method comprising pressing against the surface the layer of thermoplastic polymer of a strippable film according to any one of the preceding claims.

9. A method according to claim 8, substantially as described herein.

10. Articles the surface of which has been protected by a method as claimed in claim 8 or 9.

J. A. KEMP & CO.,
Chartered Patent Agents,
14 South Square,
Gray's Inn, London, W.C.1.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1972.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.